

NO: SMM 192(Issue 2, 20 May 2016, replacement
of SMM 192 dated 2 March 2015)

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LABORATORY LOCATION:
(PERMANENT LABORATORY)**TEKMARK SDN BHD**
NO. 7, LINTANG BATU MAUNG 1
DESA DYNAVIEV SHOPLOT
11960 BAYAN LEPAS
PULAU PINANG
MALAYSIA

This laboratory accredited under *Skim Akreditasi Makmal Malaysia (SMM)* meets the requirements of MS ISO/IEC 17025:2005 'General requirements for competence of testing and calibration laboratories'. This Malaysian Standards is identical with ISO/IEC 17025:2005 published by the International Organization for Standardization (ISO).

* The uncertainties are based on an estimated confidence probability of approximately 95% unless otherwise stated.

FIELD OF CALIBRATION: ELECTRICAL**SCOPE OF ACCREDITATION:**

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (\pm) *	Remarks
A. Indicating Meters/ Instruments DC/Low Freq 1. DC Voltage	0 to 329.9999 mV 0 to 3.299999 V 0 to 32.99999 V 0 to 329.9999 V 0 to 1000.000 V	(output + floor) 20 μ V/V + 1 μ V 11 μ V/V + 2 μ V 12 μ V/V + 20 μ V 18 μ V/V + 150 μ V 18 μ V/V + 1500 μ V	Generation using calibrator model Fluke 5520A
2. AC Voltage	1.0 mV to 1020 V (See Matrix A)	(See Matrix A)	

The valid scope of accreditation is in www.ism.gov.my/cab-directories.**Matrix A**
AC Voltage Sources

Range		Frequency (kHz)								
		0.01 to 0.045	0.045 to 10	10 to 20	20 to 50	50 to 100	100 to 500	0.045 to 1	1 to 5	5 to 10
32.999 mV	1.0 mV to 32.999 mV	0.8 + 0.006	0.15 + 0.006	0.2 + 0.006	1.0 + 0.006	3.5 + 0.012	8.0 + 0.050	-	-	-
329.999 mV	33 mV to 329.999 mV	0.3 + 0.008	0.15 + 0.008	0.16 + 0.008	0.35 + 0.008	0.8 + 0.032	2.0 + 0.070	-	-	-
3.29999 V	330 mV to 3.29999 V	0.3 + 0.05	0.15 + 0.06	0.19 + 0.06	0.3 + 0.05	0.7 + 0.125	2.4 + 0.6	-	-	-
32.9999 V	3.3 V to 32.9999 V	0.3 + 0.65	0.15 + 0.6	0.24 + 0.6	0.35 + 0.6	0.9 + 1.6	-	-	-	-
329.999 V	33 V to 329.999 V	-	-	0.25 + 6	0.3 + 6	2.0 + 50	-	0.19 + 2	0.2 + 6	0.2 + 6
1020 V	330 V to 1020 V	-	-	-	-	-	-	0.3 + 10	0.25 + 10	0.3 + 10

SKIM AKREDITASI MAKMAL MALAYSIA (SMM)
LABORATORY ACCREDITATION SCHEME FOR MALAYSIA
The calibration uncertainties given in this table are expressed in mV/V + mV

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FIELD OF CALIBRATION: ELECTRICAL**SCOPE OF ACCREDITATION:**

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (\pm) *	Remarks
3. DC Current	0 to 329.999 μ A 0 to 3.29999 mA 0 to 32.9999 mA 0 to 329.999 mA 0 to 1.09999 A 1.1 to 2.99999 A 0 to 10.9999 A 11 to 20.0 A	150 μ A/A + 0.02 μ A 100 μ A/A + 0.05 μ A 100 μ A/A + 0.25 μ A 100 μ A/A + 2.5 μ A 200 μ A/A + 40 μ A 380 μ A/A + 40 μ A 500 μ A/A + 500 μ A 1.0 mA/A + 750 μ A	Generation using calibrator model Fluke 5520A
4. AC Current	29 μA to 20.5 A (See Matrix B)	(See Matrix B)	

www.ism.gov.my/cab-directories
Matrix B
AC Current Sources

Range		Frequency (kHz)								
		0.01 to 0.02	0.02 to 0.045	0.045 to 1	1 to 5	5 to 10	10 to 30	0.010 to 0.045	0.045 to 0.1	0.1 to 1
329.99 μ A	29 μ A to 329.99 μ A	2.0 + 0.0001	1.5 + 0.0001	1.3 + 0.0001	3.0 + 0.00015	8.0 + 0.0002	16 + 0.0004	-	-	-
3.2999 mA	0.33 mA to 3.2999 mA	2.0 + 0.00015	1.3 + 0.00015	1.0 + 0.00015	2.0 + 0.0002	5.0 + 0.0003	10 + 0.0006	-	-	-
32.999 mA	3.3 mA to 32.999 mA	1.8 + 0.002	0.9 + 0.002	0.4 + 0.002	0.8 + 0.002	2.0 + 0.003	4.0 + 0.004	-	-	-
329.99 mA	33 mA to 329.99 mA	1.8 + 0.02	0.9 + 0.02	0.4 + 0.02	1.0 + 0.05	2.0 + 0.1	4.0 + 0.2	-	-	-
1.09999 A	330 mA to 1.09999 A	-	-	0.5 + 0.1	6.0 + 1	25 + 5	-	1.8 + 0.1	-	-
2.99999 A	1.1 A to 2.99999 A	-	-	0.6 + 0.1	6 + 1	25 + 5	-	1.8 + 0.1	-	-
10.9999 A	3 A to 10.9999 A	-	-	-	30 + 2	-	-	-	0.6 + 2	1 + 2
20.5 A	11 A to 20.5A	-	-	-	30 + 5	-	-	-	1.2 + 5	1.5 + 5

The calibration uncertainties given in this table are expressed in mA/A + mA

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FIELD OF CALIBRATION: ELECTRICAL**SCOPE OF ACCREDITATION:**

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (\pm) *	Remarks
5. DC Resistance	0 Ω to 10.9999 Ω 11 Ω to 32.9999 Ω 33 Ω to 109.9999 Ω 110 Ω to 1.099999 k Ω 1.1 k Ω to 10.99999 k Ω 11 k Ω to 109.9999 k Ω 110 k Ω to 1.099999 M Ω 1.1 M Ω to 3.299999 M Ω 3.3 M Ω to 10.99999 M Ω 11 M Ω to 32.99999 M Ω 33 M Ω to 109.9999 M Ω 110 M Ω to 329.9999 M Ω 330 M Ω to 1100 M Ω	40 $\mu\Omega/\Omega$ + 1.0 m Ω 30 $\mu\Omega/\Omega$ + 1.5 m Ω 28 $\mu\Omega/\Omega$ + 1.4 m Ω 28 $\mu\Omega/\Omega$ + 2.0 m Ω 28 $\mu\Omega/\Omega$ + 20 m Ω 28 $\mu\Omega/\Omega$ + 0.20 Ω 32 $\mu\Omega/\Omega$ + 2.0 Ω 60 $\mu\Omega/\Omega$ + 30 Ω 130 $\mu\Omega/\Omega$ + 50 Ω 250 $\mu\Omega/\Omega$ + 2.5 k Ω 500 $\mu\Omega/\Omega$ + 3.0 k Ω 3.0 m Ω/Ω + 100 k Ω 15 m Ω/Ω + 500 k Ω	Generation using calibrator model Fluke 5520A
6. Capacitance	0.19 nF to 3.2999 nF 3.3 nF to 10.9999 nF 11 nF to 109.999 nF 110 nF to 329.999 nF 0.33 μ F to 1.09999 μ F 1.1 μ F to 3.29999 μ F 3.3 μ F to 10.9999 μ F 11 μ F to 32.9999 μ F 33 μ F to 109.999 μ F 110 μ F to 329.999 μ F 330 μ F to 1.09999 mF 1.1 mF to 3.2999 mF 3.3 mF to 10.9999 mF 11 mF to 32.9999 mF 33 mF to 110 mF	5.0 mF/F + 10 pF 2.5 mF/F + 10 pF 2.5 mF/F + 100 pF 2.5 mF/F + 300 pF 2.5 mF/F + 1.0 nF 2.5 mF/F + 3.0 nF 2.5 mF/F + 10 nF 4.0 mF/F + 30 nF 4.5 mF/F + 100 nF 4.5 mF/F + 300 nF 4.5 mF/F + 1.0 μ F 4.5 mF/F + 3.0 μ F 4.5 mF/F + 10 μ F 7.5 mF/F + 30 μ F 11 mF/F + 100 μ F	
7. Frequency a. Source	50 kHz to 1100 MHz	2.5 μ Hz/Hz	

The valid scope is in www.ism.gov.my/cab-directories.

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FIELD OF CALIBRATION: ELECTRICAL**SCOPE OF ACCREDITATION:**

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (\pm) *	Remarks
7. Frequency b. Amplitude	<u>0.01 to 5.00 Vpp</u> 1 μ Hz to 100 kHz 100 kHz to 20 MHz 20 MHz to 30.2 MHz <u>5 to 10 Vpp</u> 1 μ Hz to 100 kHz 100 kHz to 20 MHz 20 MHz to 30.2 MHz	47 mV/ V 47 mV/ V 59 mV/ V 23 mV/ V 23 mV/ V 35 mV/ V	Generation using calibrator model DS345
B. Sources 1. DC Voltage	0 mV to 210 mV 0.21 V to 2.1 V 2.1 V to 21 V 21 V to 210 V 210 V to 1100 V	23 μ V/V+ 0.0018 mV 14 μ V /V+ 0.0000018 V 13 μ V /V+ 0.000003 V 25 μ V/V+ 0.0004 V 26 μ V /V+ 0.0004 V	Measuring using calibrator model Keithley 2002
2. AC Voltage	200 mV to 750 V (See Matrix C)	(See Matrix C)	

The valid scope is in www.ism.gov.my/cab-directories.**Matrix C****AC Voltage Measurements**

Range	Frequency (kHz)									
	0.02 to 0.05	0.05 to 0.1	0.1 to 2	2 to 10	10 to 30	30 to 50	50 to 100	100 to 200	200 to 1000	1000 to 2000
200 mV	2.5 + 0.03	0.7 + 0.03	0.2 + 0.02	0.2 + 0.02	0.25 + 0.02	0.5 + 0.02	3.0 + 0.02	7.5 + 0.05	20 +0.2	50 + 0.4
2 V	2.5 + 0.3	0.7 + 0.3	0.2 + 0.2	0.2 + 0.2	0.25 + 0.2	0.5 + 0.2	3.0 + 0.2	7.5 + 0.2	20 + 2	50 + 4
20 V	2.5 + 3	0.7 + 3	0.3 + 3	0.4 + 3	0.5 + 3	0.7 + 3	30 + 3	7.5 + 3	20 + 40	-
200 V ¹	2.5 + 30	0.7 + 30	0.3 + 30	0.4 + 30	0.5 + 30	0.7 + 30	30 + 30	-	-	-
750 V ¹	2.5 + 30	0.7 + 30	0.3 + 30	-	-	-	-	-	-	-

¹ Additional uncertainty $0.010 \text{ mV/V} \cdot (\text{Vin}/100\text{V})^2$ for input above 100V

The calibration uncertainties given in this table are expressed in mV/V + mV

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FIELD OF CALIBRATION: ELECTRICAL**SCOPE OF ACCREDITATION:**

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (\pm) *	Remarks
3. DC Current	0 μ A to 210 μ A 0 mA to 2.1 mA 0 mA to 21 mA 0 mA to 210 mA 0 A to 2 A	400 μ A/A + 0.005 μ A 390 μ A/A + 0.00004 mA 410 μ A/A + 0.0004 mA 540 μ A/A + 0.004 mA 880 μ A/A + 0.00004 A	Measuring using calibrator model Keithley 2002
	2 A to 10 A	2mA/A + 0.7mA	Measuring using calibrator model Fluke 45
4. AC Current	200 μA to 2A (See Matrix D)	(See Matrix D)	Measuring using calibrator model Keithley 2002

The valid scope is in www.ism.gov.my/cab-directories.**Matrix D****AC Current Measurements**

Range	Frequency (kHz)			
	0.02 to 0.05	0.05 to 0.2	0.2 to 1	1 to 10
200 μ A	3.5 + 0.00003	20 + 0.00003	40 + 0.00003	50 + 0.00003
2 mA	3.0 + 0.0003	1.5 + 0.0003	1.2 + 0.0003	1.2 + 0.0003
20 mA	3.0 + 0.003	1.5 + 0.003	1.2 + 0.003	1.2 + 0.003
200 mA	3.0 + 0.03	1.5 + 0.03	1.2 + 0.03	1.2 + 0.03
2 A	3.5 + 0.3	20 + 0.3	30 + 0.3	4.5 + 0.3

The calibration uncertainties given in this table are expressed in mA/A + mA

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FIELD OF CALIBRATION: ELECTRICAL**SCOPE OF ACCREDITATION:**

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (\pm) *	Remarks
5. DC Resistance	0 Ω to 20 Ω 0 Ω to 200 Ω 0 Ω to 2 k Ω 0 Ω to 20 k Ω 0 Ω to 200 k Ω 0 Ω to 2 M Ω 0 Ω to 20 M Ω 0 Ω to 200 M Ω	47 $\mu\Omega/\Omega$ + 0.00012 Ω 25 $\mu\Omega/\Omega$ + 0.0008 Ω 16 $\mu\Omega/\Omega$ + 0.0000008 k Ω 17 $\mu\Omega/\Omega$ + 0.000008 k Ω 43 $\mu\Omega/\Omega$ + 0.00018 Ω 80 $\mu\Omega/\Omega$ + 0.000001 M Ω 270 $\mu\Omega/\Omega$ + 0.000012 M Ω 570 $\mu\Omega/\Omega$ + 0.0006 M Ω	Measuring using calibrator model Keithley 2002
6. Frequency	1.0 Hz – 10 MHz 10 MHz – 100 MHz 100 MHz – 1.3 GHz	1 $\mu\text{Hz}/\text{Hz}$ + 0.1 Hz 1 $\mu\text{Hz}/\text{Hz}$ + 1 Hz 1 $\mu\text{Hz}/\text{Hz}$ + 10 Hz	Measuring using calibrator model CMC251
<u>Oscilloscope</u>			
7. Vertical Amplitude			
Pk-Pk (1 M Ω Load)	200 μV to 1 mV	2.5 mV/V + 1 μV	Generation using calibrator model Tek PG506A
Pk-Pk (50 Ω Load)	1 mV to 130 V	1.0 mV/V + 40 μV	Generation using calibrator model Fluke 5520A
	100 μV to 5 V	2.5 mV/V + 1 μV	Generation using calibrator model Tek PG506A
DC (1 M Ω Load)	5 V to 6.6 V	2.5 mV/V + 40 μV	Generation using calibrator model Fluke 5520A
DC (50 Ω Load)	0 V to 130 V	0.5 mV/V + 40 μV	
	0 V to 6.6 V	2.5 mV/V + 40 μV	
8. Time Base	1 ns to 5 s	0.5 $\mu\text{s}/\text{s}$	Generation using calibrator model Fluke TG501A

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FIELD OF CALIBRATION: ELECTRICAL**SCOPE OF ACCREDITATION:**

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (\pm) *	Remarks
9. Bandwidth Amplitude Flatness			
50 kHz to 100 MHz	5 mV to 5.5 Vp-p	(15 mV/V + 100 μ V) at ref.	Generation using calibrator model Fluke 5520A
100 MHz to 300 MHz	5 mV to 5.5 V	(20 mV/V + 100 μ V) at ref.	
300 MHz to 1050 MHz	0.5 V to 4 Vp-p	40 mV/V at ref.	Generation using calibrator model Tek SG504
1050 MHz to 1100 MHz	5 mV to 3.5 V	(50 mV/V + 100 μ V) at ref.	Generation using calibrator model Fluke 5520A
1 GHz to 4 GHz	-60 dBm to 20 dBm	0.20 dB	Leveling Method (MG3694C, NRVS, NRV-Z15, Splitter)
4 GHz to 6 GHz		0.23 dB	
6 GHz to 12.4 GHz		0.24 dB	
12.4 GHz to 15 GHz		0.25 dB	
15 GHz to 16 GHz		0.26 dB	
16 GHz to 26.5 GHz		0.27 dB	
10. Bandwidth Frequency	50 kHz to 26.5 GHz	5x10 ⁻¹⁰	Generation using calibrator model MG3694C

The valid scope is in www.ism.gov.my/cab-directories.**Signatories:**

1. Chan Boon Lye
2. Md Rizal Bin Paiman (Non resident)
3. Ramlah Binti Mamat (Non resident)
4. Lim Aing Khoon

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Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (\pm) *	Remarks
Active and Differential Probe 11. Rise Time	≥ 17.5 ps	12 ps	Generating using Pulse Generator 80E04 and measuring by DSA8200 and 80E03 sampling module

Signatories:

1. Md Rizal Bin Paiman (Non resident)
2. Lim Aing Khoo

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FIELD OF CALIBRATION: ELECTRICAL**SITE CALIBRATION: CATEGORY I****SCOPE OF ACCREDITATION:**

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (\pm) *	Remarks
A. Indicating Meters/ Instruments DC/Low Freq 1. DC Voltage	0 to 329.9999 mV 0 to 3.299999 V 0 to 32.99999 V 0 to 329.9999 V 0 to 1000.000 V	(output + floor) 20 μ V/V + 1 μ V 11 μ V/V + 2 μ V 12 μ V/V + 20 μ V 18 μ V/V + 150 μ V 18 μ V/V + 1500 μ V	Generation using calibrator model Fluke 5520A
2. AC Voltage	1.0 mV to 1020 V (See Matrix A)	(See Matrix A)	

The valid scope is in www.ism.gov.my/cab-directories.**Matrix A**
AC Voltage Sources

Range		Frequency (kHz)								
		0.01 to 0.045	0.045 to 10	10 to 20	20 to 50	50 to 100	100 to 500	0.045 to 1	1 to 5	5 to 10
32.999 mV	1.0 mV to 32.999 mV	0.8 + 0.006	0.15 + 0.006	0.2 + 0.006	1.0 + 0.006	3.5 + 0.012	8.0 + 0.050	-	-	-
329.999 mV	33 mV to 329.999 mV	0.3 + 0.008	0.15 + 0.008	0.16 + 0.008	0.35 + 0.008	0.8 + 0.032	2.0 + 0.070	-	-	-
3.29999 V	330 mV to 3.29999 V	0.3 + 0.05	0.15 + 0.06	0.19 + 0.06	0.3 + 0.05	0.7 + 0.125	2.4 + 0.6	-	-	-
32.9999 V	3.3 V to 32.9999 V	0.3 + 0.65	0.15 + 0.6	0.24 + 0.6	0.35 + 0.6	0.9 + 1.6	-	-	-	-
329.999 V	33 V to 329.999 V	-	-	0.25 + 6	0.3 + 6	2.0 + 50	-	0.19 + 2	0.2 + 6	0.2 + 6
1020 V	330 V to 1020 V	-	-	-	-	-	-	0.3 + 10	0.25 + 10	0.3 + 10

The calibration uncertainties given in this table are expressed in mV/V + mV

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FIELD OF CALIBRATION: ELECTRICAL**SITE CALIBRATION: CATEGORY I****SCOPE OF ACCREDITATION:**

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (\pm) *	Remarks
3. DC Current	0 to 329.999 μ A 0 to 3.29999 mA 0 to 32.9999 mA 0 to 329.999 mA 0 to 1.09999 A 1.1 to 2.99999 A 0 to 10.9999 A 11 to 20.0 A	150 μ A/A + 0.02 μ A 100 μ A/A + 0.05 μ A 100 μ A/A + 0.25 μ A 100 μ A/A + 2.5 μ A 200 μ A/A + 40 μ A 380 μ A/A + 40 μ A 500 μ A/A + 500 μ A 1.0 mA/A + 750 μ A	Generation using calibrator model Fluke 5520A
4. AC Current	29 μA to 20.5 A (See Matrix B)	(See Matrix B)	

The valid scope is in www.ism.gov.my/cab-directories.**Matrix B****AC Current Sources**

Range		Frequency (kHz)								
		0.01 to 0.02	0.02 to 0.045	0.045 to 1	1 to 5	5 to 10	10 to 30	0.010 to 0.045	0.045 to 0.1	0.1 to 1
329.99 μ A	29 μ A to 329.99 μ A	2.0 + 0.0001	1.5 + 0.0001	1.3 + 0.0001	3.0 + 0.00015	8.0 + 0.0002	16 + 0.0004	-	-	-
3.2999 mA	0.33 mA to 3.2999 mA	2.0 + 0.00015	1.3 + 0.00015	1.0 + 0.00015	2.0 + 0.0002	5.0 + 0.0003	10 + 0.0006	-	-	-
32.999 mA	3.3 mA to 32.999 mA	1.8 + 0.002	0.9 + 0.002	0.4 + 0.002	0.8 + 0.002	2.0 + 0.003	4.0 + 0.004	-	-	-
329.99 mA	33 mA to 329.99 mA	1.8 + 0.02	0.9 + 0.02	0.4 + 0.02	1.0 + 0.05	2.0 + 0.1	4.0 + 0.2	-	-	-
1.09999 A	330 mA to 1.09999 A	-	-	0.5 + 0.1	6.0 + 1	25 + 5	-	1.8 + 0.1	-	-
2.99999 A	1.1 A to 2.99999 A	-	-	0.6 + 0.1	6 + 1	25 + 5	-	1.8 + 0.1	-	-
10.9999 A	3 A to 10.9999 A	-	-	-	30 + 2	-	-	-	0.6 + 2	1 + 2
20.5 A	11 A to 20.5A	-	-	-	30 + 5	-	-	-	1.2 + 5	1.5 +5

The calibration uncertainties given in this table are expressed in mA/A + mA

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FIELD OF CALIBRATION: ELECTRICAL**SITE CALIBRATION: CATEGORY I****SCOPE OF ACCREDITATION:**

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (\pm) *	Remarks
5. DC Resistance	0 to 10.9999 Ω 11 Ω to 32.9999 Ω 33 Ω to 109.9999 Ω 110 Ω to 1.099999 k Ω 1.1 k Ω to 10.99999 k Ω 11 k Ω to 109.9999 k Ω 110 k Ω to 1.099999 M Ω 1.1 M Ω to 3.299999 M Ω 3.3 M Ω to 10.99999 M Ω 11 M Ω to 32.99999 M Ω 33 M Ω to 109.9999 M Ω 110 M Ω to 329.9999 M Ω 330 M Ω to 1100 M Ω	40 $\mu\Omega/\Omega$ + 1.0 m Ω 30 $\mu\Omega/\Omega$ + 1.5 m Ω 28 $\mu\Omega/\Omega$ + 1.4 m Ω 28 $\mu\Omega/\Omega$ + 2.0 m Ω 28 $\mu\Omega/\Omega$ + 20 m Ω 28 $\mu\Omega/\Omega$ + 0.20 Ω 32 $\mu\Omega/\Omega$ + 2.0 Ω 60 $\mu\Omega/\Omega$ + 30 Ω 130 $\mu\Omega/\Omega$ + 50 Ω 250 $\mu\Omega/\Omega$ + 2.5 k Ω 500 $\mu\Omega/\Omega$ + 3.0 k Ω 3.0 m Ω/Ω + 100 k Ω 15 m Ω/Ω + 500 k Ω	Generation using calibrator model Fluke 5520A
6. Capacitance	0.19 nF to 3.2999 nF 3.3 nF to 10.9999 nF 11 nF to 109.999 nF 110 nF to 329.999 nF 0.33 μ F to 1.09999 μ F 1.1 μ F to 3.29999 μ F 3.3 μ F to 10.9999 μ F 11 μ F to 32.9999 μ F 33 μ F to 109.999 μ F 110 μ F to 329.999 μ F 330 μ F to 1.09999 mF 1.1 mF to 3.2999 mF 3.3 mF to 10.9999 mF 11 mF to 32.9999 mF 33 mF to 110 mF	5.0 mF/F + 10 pF 2.5 mF/F + 10 pF 2.5 mF/F + 100 pF 2.5 mF/F + 300 pF 2.5 mF/F + 1.0 nF 2.5 mF/F + 3.0 nF 2.5 mF/F + 10 nF 4.0 mF/F + 30 nF 4.5 mF/F + 100 nF 4.5 mF/F + 300 nF 4.5 mF/F + 1.0 μ F 4.5 mF/F + 3.0 μ F 4.5 mF/F + 10 μ F 7.5 mF/F + 30 μ F 11 mF/F + 100 μ F	
7. Frequency a. Source	50 kHz to 1100 MHz	2.5 μ Hz/Hz	

The valid scope is in www.ism.gov.my/cab-directories.

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FIELD OF CALIBRATION: ELECTRICAL

SITE CALIBRATION: CATEGORY I

SCOPE OF ACCREDITATION:

The valid scope is in www.ism.gov.my/cab-directories.

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (\pm) *	Remarks
7. Frequency b. Amplitude	<u>0.01 to 5.00 Vpp</u> 1 μ Hz to 100 kHz 100 kHz to 20 MHz 20 MHz to 30.2 MHz <u>5 to 10 Vpp</u> 1 μ Hz to 100 kHz 100 kHz to 20 MHz 20 MHz to 30.2 MHz	47 mV/ V 47 mV/ V 59 mV/ V 23 mV/ V 23 mV/ V 35 mV/ V	Generation using calibrator model DS345
B. Sources 1. DC Voltage	0 mV to 210 mV 0.21 V to 2.1 V 2.1 V to 21 V 21 V to 210 V 210 V to 1100 V	23 μ V/V+ 0.0018 mV 14 μ V /V+ 0.0000018 V 13 μ V /V+ 0.000003 V 25 μ V/V+ 0.0004 V 26 μ V /V+ 0.0004 V	Measuring using calibrator model Keithley 2002
2. AC Voltage	200 mV to 750 V (See Matrix C)	(See Matrix C)	

**Matrix C
AC Voltage Measurements**

Range	Frequency (kHz)									
	0.02 to 0.05	0.05 to 0.1	0.1 to 2	2 to 10	10 to 30	30 to 50	50 to 100	100 to 200	200 to 1000	1000 to 2000
200 mV	2.5 + 0.03	0.7 + 0.03	0.2 + 0.02	0.2 + 0.02	0.25 + 0.02	0.5 + 0.02	3.0 + 0.02	7.5 + 0.05	20 + 0.2	50 + 0.4
2 V	2.5 + 0.3	0.7 + 0.3	0.2 + 0.2	0.2 + 0.2	0.25 + 0.2	0.5 + 0.2	3.0 + 0.2	7.5 + 0.2	20 + 2	50 + 4
20 V	2.5 + 3	0.7 + 3	0.3 + 3	0.4 + 3	0.5 + 3	0.7 + 3	30 + 3	7.5 + 3	20 + 40	-
200 V ¹	2.5 + 30	0.7 + 30	0.3 + 30	0.4 + 30	0.5 + 30	0.7 + 30	30 + 30	-	-	-
750 V ¹	2.5 + 30	0.7 + 30	0.3 + 30	-	-	-	-	-	-	-

¹ Additional uncertainty 0.010 mV/V*(Vin/100V)² for input above 100V
The calibration uncertainty is given in this table in mV/V + mV

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FIELD OF CALIBRATION: ELECTRICAL**SITE CALIBRATION: CATEGORY I****SCOPE OF ACCREDITATION:**

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (\pm) *	Remarks
3. DC Current	0 μ A to 210 μ A 0 mA to 2.1 mA 0 mA to 21 mA 0 mA to 210 mA 0 A to 2 A	400 μ A/A + 0.005 μ A 390 μ A/A + 0.00004 mA 410 μ A/A + 0.0004 mA 540 μ A/A + 0.004 mA 880 μ A/A + 0.00004 A	Measuring using calibrator model Keithley 2002
	2 A to 10 A	2mA/A + 0.7mA	Measuring using calibrator model Fluke 45
4. AC Current	200 μA to 2 A (See Matrix D)	(See Matrix D)	Measuring using calibrator model Keithley 2002

The valid scope is in www.ism.gov.my/cab-directories.**Matrix D****AC Current Measurements**

Range	Frequency (kHz)			
	0.02 to 0.05	0.05 to 0.2	0.2 to 1	1 to 10
200 μ A	3.5 + 0.00003	20 + 0.00003	40 + 0.00003	50 + 0.00003
2 mA	3.0 + 0.0003	1.5 + 0.0003	1.2 + 0.0003	1.2 + 0.0003
20 mA	3.0 + 0.003	1.5 + 0.003	1.2 + 0.003	1.2 + 0.003
200 mA	3.0 + 0.03	1.5 + 0.03	1.2 + 0.03	1.2 + 0.03
2 A	3.5 + 0.3	20 + 0.3	30 + 0.3	4.5 + 0.3

The calibration uncertainties given in this table are expressed in mA/A + mA

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FIELD OF CALIBRATION: ELECTRICAL**SITE CALIBRATION: CATEGORY I****SCOPE OF ACCREDITATION:**

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (\pm) *	Remarks
5. DC Resistance	0 Ω to 20 Ω 0 Ω to 200 Ω 0 Ω to 2 k Ω 0 Ω to 20 k Ω 0 Ω to 200 k Ω 0 Ω to 2 M Ω 0 Ω to 20 M Ω 0 Ω to 200 M Ω	47 $\mu\Omega/\Omega$ + 0.00012 Ω 25 $\mu\Omega/\Omega$ + 0.0008 Ω 16 $\mu\Omega/\Omega$ + 0.0000008 k Ω 17 $\mu\Omega/\Omega$ + 0.000008 k Ω 43 $\mu\Omega/\Omega$ + 0.00018 Ω 80 $\mu\Omega/\Omega$ + 0.000001 M Ω 270 $\mu\Omega/\Omega$ + 0.000012 M Ω 570 $\mu\Omega/\Omega$ + 0.0006 M Ω	Measuring using calibrator model Keithley 2002
6. Frequency	1.0 Hz – 10 MHz 10 MHz – 100 MHz 100 MHz – 1.3 GHz	1 μ Hz/Hz + 0.1 Hz 1 μ Hz/Hz + 1 Hz 1 μ Hz/Hz + 10 Hz	Measuring using calibrator model CMC251
Oscilloscope			
7. Vertical Amplitude			
Pk-Pk (1 M Ω Load)	200 μ V to 1 mV	2.5 mV/V + 1 μ V	Generation using calibrator model Tek PG506A
Pk-Pk (50 Ω Load)	1 mV to 130 V	1.0 mV/V + 40 μ V	Generation using calibrator model Fluke 5520A
	100 μ V to 5 V	2.5 mV/V + 1 μ V	Generation using calibrator model Tek PG506A
DC (1 M Ω Load)	5 V to 6.6 V	2.5 mV/V + 40 μ V	Generation using calibrator model Fluke 5520A
DC (50 Ω Load)	0 V to 130 V	0.5 mV/V + 40 μ V	
	0 V to 6.6 V	2.5 mV/V + 40 μ V	
8. Time Base	1 ns to 5 s	0.5 μ s/s	Generation using calibrator model Fluke TG501A

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FIELD OF CALIBRATION: ELECTRICAL**SITE CALIBRATION: CATEGORY I****SCOPE OF ACCREDITATION:**

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (\pm) *	Remarks
9. Bandwidth Amplitude Flatness			
50 kHz to 100 MHz	5mV to 5.5 Vp-p	(15 mV/V + 100uV) at ref	Generation using calibrator model Fluke 5520A
100 MHz to 300 MHz	5mV to 5.5 V	(20 mV/V + 100 μ V) at ref.	
300 MHz to 1050 MHz	0.5 V to 4 Vp-p	40 mV/V at ref.	Generation using calibrator model Tek SG504
1050 MHz to 1100 MHz	5 mV to 3.5 V	(50 mV/V + 100 μ V) at ref.	Generation using calibrator model Fluke 5520A
1 GHz to 4 GHz	-60 dBm to 20 dBm	0.20 dB	Leveling Method (MG3694C, NRVS, NRV-Z15, Splitter)
4 GHz to 6 GHz		0.23 dB	
6 GHz to 12.4 GHz		0.24 dB	
12.4 GHz to 15 GHz		0.25 dB	
15 GHz to 16 GHz		0.26 dB	
16 GHz to 26.5 GHz		0.27 dB	
10. Bandwidth Frequency	50 kHz to 26.5 GHz	5×10^{-10}	Generation using calibrator model MG3694C

The valid scope is in www.ism.gov.my/cab-directories.**Signatories:**

1. Chan Boon Lye
2. Md Rizal Bin Paiman (Non resident)
4. Ramlah Binti Mamat (Non resident)
5. Lim Aing Khoon

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FIELD OF CALIBRATION: ELECTRICAL**SITE CALIBRATION: CATEGORY I****SCOPE OF ACCREDITATION:**

Instrument calibrated/ Measurement parameter	Range	Calibration and Measurement Capability expressed as an uncertainty (\pm) *	Remarks
Active and Differential Probe 16. Rise Time	≥ 17.5 ps	12 ps	Generating using Pulse Generator 80E04 and measuring by DSA8200 and 80E03 sampling module

The valid scope is in www.ism.gov.my/cab-directories.**Signatory:**

1. Md Rizal Bin Paiman (Non resident)
2. Lim Aing Khoon